Trend Study 16A-3-02

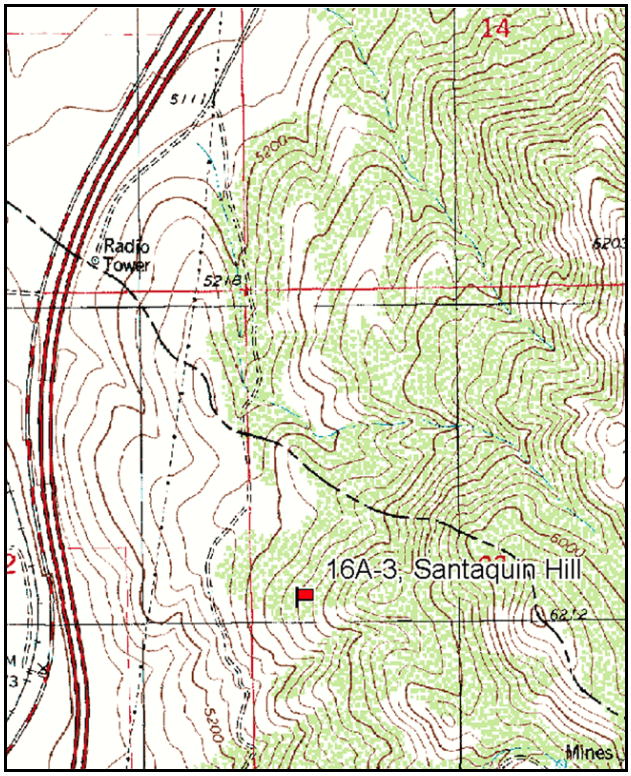
Study site name: Santaquin Hill. Vegetation type: Mixed Oak-Sage.

Compass bearing: frequency baseline 350 degrees magnetic (lines 2-4 @ 143°M).

Frequency belt placement: line 1 (11& 95ft), line 2 (59ft), line 3 (34ft), line 4 (71ft).

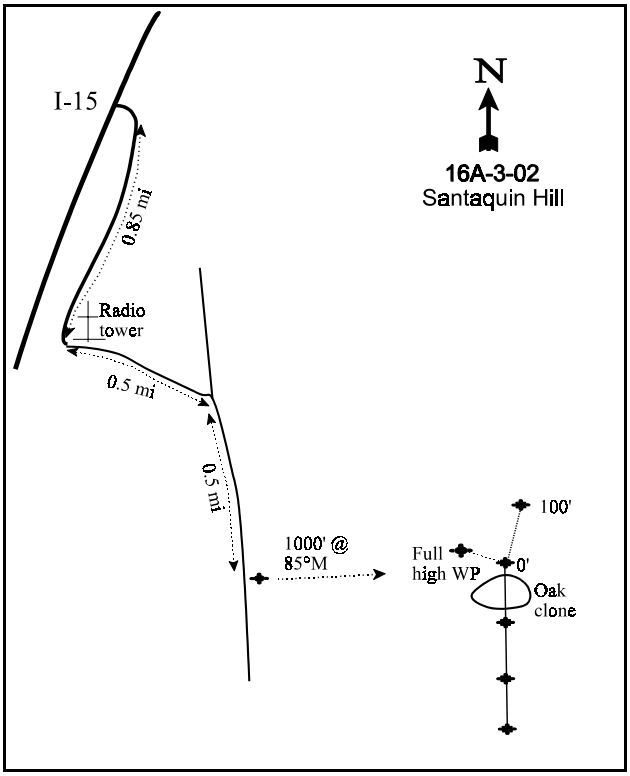
LOCATION DESCRIPTION

From the south Santaquin exit on I-15, proceed easterly under the overpass and then southerly onto the frontage road for 0.85 miles to the radio tower. Proceed over the ridge to the east of the radio tower on faint rd for 0.5 miles to an intersection with a dirt road. Proceed south for 0.5 miles to a half high witness post on the east side of the road. From the witness post, walk 1,000 feet at 85 degrees magnetic up the ridge to a full high witness post. The 0-foot baseline stake is 20 feet south of the witness post. The study is marked by green steel "T" fenceposts approximately 12 to 18 inches in height. A red browse tag, #3967, is attached to the 0-foot baseline stake.



Map Name: Santaquin

Township 10S, Range 1E, Section 22



Diagrammatic Sketch

GPS: NAD 27, UTM 12S 4420039 N 431487 E

DISCUSSION

Santaquin Hill - Trend Study No. 16A-3

This trend study is located on critical deer and elk winter range on Division property. The area straddles the Juab county line near the top of Santaquin Hill. The study is on a broad ridge which slopes moderately (16%) to the west and has an elevation of approximately 5,500 feet. It is a big sagebrush-grass community which contains large numbers of low-growing Gambel oak. Higher up on the hill, Gambel oak becomes increasingly more dominant and taller. Considerable evidence of deer and elk use in the form of pellet groups, antler drops, and forage use was apparent in 1983. Pellet group data from 1997 and 2002 estimate moderate deer use with a quadrat frequency of deer pellet groups at 22% and 33% respectively. A pellet group transect read along the study site baseline in 2002 estimated 112 deer days use/acre (276 ddu/ha).

Soil at the study site is shallow and exceptionally rocky. The soil survey classifies this soil as an "extremely stony loam" with a 2 to 8 inch deep surface horizon. A typical profile of the surface layer is grey-brown in color, slightly calcareous, and mildly alkaline. The soil also possesses a thick lime hardpan beginning about 13 inches below the surface. Root penetration through the hardpan is very difficult (USDA-SCS, 1972). Soil at the site is relatively deep with an effective rooting depth of 15 inches. Texture is a clay loam with a neutral pH of 6.8. Protective ground cover appears adequate to prevent serious erosion. The erosion condition classification was determined to be stable in 2002.

Browse on the site consists of mountain big sagebrush and low growing Gambel oak. Sagebrush accounts for the largest majority of the shrub cover with a population density of 2,780 plants/acre in 1997 and 2,940 plants/acre in 2002. Density has been relatively stable since 1983 even though about 1/3 of the population consisted of dead plants in 1997 and 2002. This would suggest a relatively rapid turnover for sagebrush on this site. Use was moderate to heavy in 1983 with lighter use in 1989. Use was again moderate in 1997 and 2002, with heavy use reported on 12% and 28% of the sagebrush respectively. Percent decadency was high in 1989 at 63%, but that has since declined to 27% in 1997 and 39% in 2002. Young recruitment is low at only 5% in 2002 and not adequate to replace the decadent and dying sagebrush (766 plants/acre). Density of mature plants has remained stable between 1997 and 2002. Vigor of mature plants is good and annual leader growth averaged 1.7 inches in 2002.

Gambel oak provided 42% of the browse cover on the site in 1997 and 35% in 2002. The original 100 foot baseline established in 1983 had a higher density of oak than the extended 400 foot baseline established in 1997. As a result, the sampled population density declined from 9,332 plants/acre in 1989 to 3,140 in 1997. Oak on the site is low growing and averages only about 30 inches in height. Use has previously been light to moderate, but was reported moderate to heavy in 1997 when nearly half (43%) of the oak was classified as heavily hedged. Oak is often difficult to classify with regard to the degree of hedging. Some of the increase in use may be due to observer differences combined with the stunted growth habit of the oak on this site. Use of oak was reported to be mostly light in 2002. About 9% of the mature oak sampled had poor vigor due to a late spring frost in 2002. Overall, the oak is healthy and vigorous with good vigor and a low rate of decadency.

The herbaceous understory is relatively depleted. Bluebunch wheatgrass is abundant providing 75% of the grass cover in 1997, increasing to 82% in 2002. Sandberg bluegrass is also numerous, but does not produce much forage. The annual grasses, cheatgrass and Japanese brome, are also common. Forbs are diverse yet are totally dominated by annuals. Common species include pale alyssum, annual bedstraw, and bur buttercup. Perennial forbs are rare. All forbs combined produced only about 4% cover in 1997 and 2002.

1983 APPARENT TREND ASSESSMENT

The soil appears stable. Aerial cover from shrubs, rock cover, and a limited amount of litter help prevent serious erosion. However, the lack of a strong perennial understory has allowed some soil movement to continue. No improvement appears to be coming in the near future. The sagebrush community appears stable with oak likely to gradually increase in density and cover.

1989 TREND ASSESSMENT

The soil trend has improved due to a decline in percent bare ground from 18% to only 7%. In addition, ground cover estimates show an increase in the percentage of basal vegetative cover to almost 8%. Although not in direct competition with oakbrush in most places and generally only lightly hedged, the mountain big sagebrush on this site is declining. In 1989, the population was classified as 63% decadent, with few young shrubs. Sagebrush decreased slightly in density from 3,199 plants/acre in 1983 to 2,732 plants/acre in 1989. Sagebrush cover on the site averages about 8%. The density of young oak increased, but some of the increase may be do to classification problems between observers caused by the low growth habit of the oak. Trend for the herbaceous understory is up due to a significant increase in the sum of nested frequency of bluebunch wheatgrass and Sandberg bluegrass. Nested frequency of perennial forbs also increased. The most common perennial forb species remain longleaf phlox, sego lily, and Astragalus, yet total forb cover is low.

TREND ASSESSMENT
soil - up (5)
browse - down slightly (2)
herbaceous understory - up (5)

1997 TREND ASSESSMENT

Soil trend is stable. Percent cover of bare ground has remained at about 7%. Trend for mountain big sagebrush is now stable. Population density is similar to 1989 estimates and percent decadency has declined from 63% to 27%. Dead plants are abundant (ratio of 1:3.4) and most of the decadent plants sampled (68%) were classified as dying. However, the constant density and good recruitment would indicate a relatively rapid turn over for sagebrush on this site. Population of Gambel oak declined 66% primarily due to the larger sample size used. Oak is healthy and vigorous and appears stable. Trend for the herbaceous understory is down slightly due to a decline in the sum of nested frequency of perennial grasses. Nested frequency of bluebunch wheatgrass and Sandberg bluegrass both declined. Perennial forbs are still rare with sum of nested frequency remaining similar to that in 1989.

TREND ASSESSMENT
soil - stable (3)
browse - stable (3)
herbaceous understory - down slightly (2)

2002 TREND ASSESSMENT

Trend for soil is stable. There is good protective ground cover leaving only about 6% bare ground. In addition, the soil erosion condition classification was determined as stable in 2002. Trend for the key browse species, mountain big sagebrush, is stable. However, there are several areas of concern. Recruitment is poor with only 5% of the population consisting of young plants and seedlings are rare. The number of decadent plants has increased from 27% in 1997 to 39% in 2002. In addition, 66% or 760 plants/acre of the decadent sagebrush sampled were classified as dying. These trends are most likely the result of drought. A continuation of drought conditions will cause a future population decline, but for now, the population appears stable. Trend for the herbaceous understory is stable. Sum of nested frequency of the dominant grasses, bluebunch wheatgrass and Sandberg bluegrass, has remained stable. Forbs are diverse but perennial forbs are rare.

TREND ASSESSMENT
soil - stable (3)
browse - stable (3)
herbaceous understory - stable (3)

HERBACEOUS TRENDS --
Herd unit 16A, Study no: 3

Type	Species	Nested Frequency				Quadrat Frequency				Average Cover %	
		'83	'89	'97	'02	'83	'89	'97	'02	'97	'02
G	Agropyron spicatum	a181	b246	b230	b253	76	86	82	93	10.56	10.89
G	Bromus japonicus (a)	-	-	b129	a-	-	-	43	-	1.89	-
G	Bromus tectorum (a)	-	-	117	125	-	-	49	46	.76	1.83
G	Poa pratensis	8	7	-	3	4	3	-	1	-	.03
G	Poa secunda	a74	b153	a102	a85	35	66	40	35	.85	.50
Total for Annual Grasses		0	0	246	125	0	0	92	46	2.66	1.83
Total for Perennial Grasses		263	406	332	341	115	155	122	129	11.42	11.42
Total for Grasses		263	406	578	466	115	155	214	175	14.09	13.26
F	Alyssum alyssoides (a)	-	-	293	302	-	-	92	90	2.36	3.38
F	Antennaria rosea	-	-	1	2	-	-	1	1	.00	.00
F	Arabis spp.	2	10	7	-	2	7	4	-	.02	-
F	Astragalus beckwithii	-	-	2	1	-	-	2	1	.05	.00
F	Astragalus cibarius	b11	ab5	b11	a-	6	3	6	-	.21	-
F	Astragalus eurekensis	1	3	-	2	1	2	-	2	-	.01
F	Castilleja linariaefolia	-	-	-	1	-	-	-	1	.00	.00
F	Calochortus nuttallii	5	23	12	18	5	10	7	10	.03	.07
F	Chaenactis douglasii	6	5	7	-	4	3	3	-	.04	-
F	Cirsium undulatum	-	-	-	-	-	-	-	-	-	.00
F	Comandra pallida	-	-	-	4	-	-	-	2	-	.01
F	Collinsia parviflora (a)	-	-	21	17	-	-	10	10	.05	.07
F	Crepis acuminata	-	2	4	2	-	2	1	1	.00	.00
F	Draba spp. (a)	-	-	3	-	-	-	1	-	.00	-
F	Epilobium brachycarpum (a)	-	-	36	20	-	-	16	10	.08	.05

Type	Species	Nested Frequency				Quadrat Frequency				Average Cover %	
		'83	'89	'97	'02	'83	'89	'97	'02	'97	'02
F	Eriogonum brevicaule	-	-	-	1	-	-	-	1	-	.00
F	Erigeron pumilus	-	-	1	-	-	-	1	-	.00	-
F	Galium aparine (a)	-	-	43	40	-	-	19	19	.48	.14
F	Helianthus annuus (a)	-	-	3	-	-	-	1	-	.00	-
F	Holosteum umbellatum (a)	-	-	5	7	-	-	2	3	.01	.01
F	Lactuca serriola	-	-	9	1	-	-	4	1	.02	.00
F	Microsteris gracilis (a)	-	-	30	27	-	-	12	14	.06	.07
F	Petradoria pumila	-	-	1	3	-	-	1	2	.03	.15
F	Phlox longifolia	$_{a}$8	$_{b}$30	$_{ab}$28	$_{ab}$24	6	18	11	11	.05	.05
F	Ranunculus testiculatus (a)	-	-	50	67	-	-	16	26	.13	.25
F	Streptanthus cordatus	1	3	-	-	1	1	-	-	-	-
F	Taraxacum officinale	-	-	-	1	-	-	-	1	-	.00
F	Tragopogon dubius	8	-	2	5	4	-	1	2	.03	.01
Total for Annual Forbs		0	0	484	480	0	0	169	172	3.19	4.00
Total for Perennial Forbs		42	81	85	65	29	46	42	36	0.52	0.35
Total for Forbs		42	81	569	545	29	46	211	208	3.71	4.35

Values with different subscript letters are significantly different at alpha = 0.10

BROWSE TRENDS --
Herd unit 16A, Study no: 3

Type	Species	Strip Frequency		Average Cover %	
		'97	'02	'97	'02
B	Artemisia tridentata vaseyana	70	72	10.42	8.92
B	Chrysothamnus nauseosus albicaulis	7	3	.66	.16
B	Gutierrezia sarothrae	23	10	.81	.03
B	Quercus gambelii	30	33	8.67	4.98
Total for Browse		130	118	20.58	14.10

Key Browse Annual Leader Growth
Herd unit 16A , Study no: 3

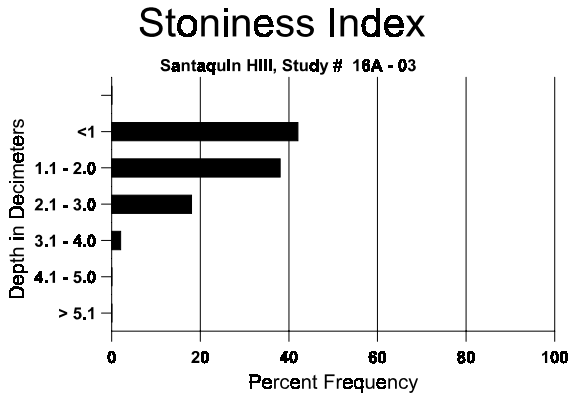
Species	Average leader growth (in)
	'02
Artemisia tridentata vaseyana	1.7

BASIC COVER --
Herd unit 16A, Study no: 3

Cover Type	Nested Frequency		Average Cover %			
	'97	'02	'83	'89	'97	'02
Vegetation	357	357	0	7.50	35.97	33.26
Rock	281	302	17.00	15.00	23.06	25.70
Pavement	157	167	4.00	14.00	3.11	4.19
Litter	393	386	61.50	55.25	47.94	47.63
Cryptogams	92	34	0	1.25	.57	.31
Bare Ground	211	178	17.50	7.00	7.12	5.78

SOIL ANALYSIS DATA --
Herd Unit 16A, Study no: 03, Santaquin Hill

Effective rooting depth (in)	Temp °F (depth)	pH	%sand	%silt	%clay	%0M	PPM P	PPM K	dS/m
15.3	54.8 (16.0)	6.8	40.4	29.1	30.6	3.2	16.3	204.8	.6



PELLET GROUP FREQUENCY --
Herd unit 16A, Study no: 3

Type	Quadrat Frequency		Pellet Transect	
	'97	'02	Pellet Groups per Acre '02	Days Use per Acre (ha) '02
Rabbit	11	15	-	-
Elk	2	2	-	-
Deer	20	33	1453	112 (276)

BROWSE CHARACTERISTICS --
Herd unit 16A, Study no: 3

AGE	YR	Form Class (No. of Plants) 1	2	3	4	5	6	7	8	9	Vigor Class 1	2	3	4	Plants Per Acre	Average (inches) Ht.	Cr.	Total
Artemisia tridentata vaseyana																		
S	83	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	89	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	97	5	-	-	-	-	-	-	-	-	5	-	-	-	100			5
	02	1	-	-	-	-	-	-	-	-	1	-	-	-	20			1
Y	83	2	-	-	-	-	-	-	-	-	2	-	-	-	133			2
	89	2	-	-	-	-	-	-	-	-	2	-	-	-	133			2
	97	26	-	-	-	-	-	-	-	-	26	-	-	-	520			26
	02	4	4	-	-	-	-	-	-	-	8	-	-	-	160			8
M	83	6	24	4	-	-	-	-	-	-	34	-	-	-	2266	18	21	34
	89	9	3	-	1	-	-	-	-	-	10	-	3	-	866	17	22	13
	97	31	41	2	-	1	-	-	-	-	75	-	-	-	1500	17	25	75
	02	22	29	27	2	-	-	1	-	-	81	-	-	-	1620	20	31	81
D	83	1	10	1	-	-	-	-	-	-	12	-	-	-	800			12
	89	21	5	-	-	-	-	-	-	-	20	1	3	2	1733			26
	97	5	18	13	-	-	2	-	-	-	12	-	-	26	760			38
	02	18	23	13	-	-	1	3	-	-	20	-	-	38	1160			58
X	83	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	89	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	97	-	-	-	-	-	-	-	-	-	-	-	-	-	1140			57
	02	-	-	-	-	-	-	-	-	-	-	-	-	-	1700			85

% Plants Showing	Moderate Use	Heavy Use	Poor Vigor	%Change
'83	71%	10%	00%	-15%
'89	20%	00%	20%	+ 2%
'97	43%	12%	19%	+ 5%
'02	38%	28%	26%	

Total Plants/Acre (excluding Dead & Seedlings)				
	'83	3199	Dec:	25%
	'89	2732		63%
	'97	2780		27%
	'02	2940		39%

AGE	YR	Form Class (No. of Plants) 1	2	3	4	5	6	7	8	9	Vigor Class 1	2	3	4	Plants Per Acre	Average (inches) Ht.	Cr.	Total
Chrysothamnus nauseosus albicaulis																		
M	83	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	0
	89	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	0
	97	5	1	-	-	-	1	-	-	-	7	-	-	-	140	27	35	7
	02	3	-	-	-	-	-	-	-	-	3	-	-	-	60	29	47	3
D	83	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	89	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	97	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	02	1	-	-	-	-	-	-	-	-	-	-	-	1	20			1
X	83	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	89	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	97	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	02	-	-	-	-	-	-	-	-	-	-	-	-	-	60			3

% Plants Showing	Moderate Use	Heavy Use	Poor Vigor	%Change
'83	00%	00%	00%	
'89	00%	00%	00%	
'97	14%	14%	00%	-43%
'02	00%	00%	25%	

Total Plants/Acre (excluding Dead & Seedlings)			Dec:
	'83	0	0%
	'89	0	0%
	'97	140	0%
	'02	80	25%

AGE	YR	Form Class (No. of Plants) 1	2	3	4	5	6	7	8	9	Vigor Class 1	2	3	4	Plants Per Acre	Average (inches) Ht.	Cr.	Total
Gutierrezia sarothrae																		
S	83	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	89	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	97	1	-	-	-	-	-	-	-	-	1	-	-	-	20			1
	02	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
Y	83	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	89	12	-	-	-	-	-	-	-	-	12	-	-	-	800			12
	97	3	-	-	-	-	-	-	-	-	3	-	-	-	60			3
	02	1	-	-	-	-	-	-	-	-	1	-	-	-	20			1
M	83	8	-	-	-	-	-	-	-	-	8	-	-	-	533	16	10	8
	89	24	-	-	-	-	-	-	-	-	24	-	-	-	1600	9	12	24
	97	33	-	-	-	-	-	-	-	-	33	-	-	-	660	8	7	33
	02	10	-	-	-	-	-	-	-	-	8	2	-	-	200	6	7	10
D	83	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	89	4	-	-	-	-	-	-	-	-	4	-	-	-	266			4
	97	1	-	-	-	-	-	-	-	-	1	-	-	-	20			1
	02	2	-	-	-	-	-	-	-	-	-	-	-	2	40			2
X	83	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	89	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	97	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	02	-	-	-	-	-	-	-	-	-	-	-	-	-	240			12

% Plants Showing	Moderate Use	Heavy Use	Poor Vigor	%Change
'83	00%	00%	00%	+80%
'89	00%	00%	00%	-72%
'97	00%	00%	00%	-65%
'02	00%	00%	15%	

Total Plants/Acre (excluding Dead & Seedlings)				
	'83	533	Dec:	0%
	'89	2666		10%
	'97	740		3%
	'02	260		15%

AGE	YR	Form Class (No. of Plants) 1	2	3	4	5	6	7	8	9	Vigor Class 1	2	3	4	Plants Per Acre	Average (inches) Ht.	Cr.	Total
Quercus gambelii																		
S	83	11	-	-	-	-	-	-	-	-	11	-	-	-	733			11
	89	-	-	-	-	-	-	19	-	-	19	-	-	-	1266			19
	97	5	-	-	-	-	-	-	-	-	5	-	-	-	100			5
	02	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
Y	83	16	12	-	-	-	-	-	-	-	28	-	-	-	1866			28
	89	78	24	-	24	-	-	-	-	-	126	-	-	-	8400			126
	97	35	7	-	-	-	-	-	-	-	42	-	-	-	840			42
	02	5	1	2	-	-	-	-	-	-	8	-	-	-	160			8
M	83	-	75	-	-	-	-	-	-	-	75	-	-	-	5000	27	18	75
	89	4	8	-	1	-	-	-	-	-	13	-	-	-	866	33	21	13
	97	13	9	62	-	25	2	-	-	-	111	-	-	-	2220	30	29	111
	02	280	1	54	-	-	-	-	-	-	306	-	29	-	6700	32	20	335
D	83	-	4	-	-	-	-	-	-	-	4	-	-	-	266			4
	89	1	-	-	-	-	-	-	-	-	1	-	-	-	66			1
	97	-	-	2	-	-	2	-	-	-	3	-	-	1	80			4
	02	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
X	83	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	89	-	-	-	-	-	-	-	-	-	-	-	-	-	0			0
	97	-	-	-	-	-	-	-	-	-	-	-	-	-	80			4
	02	-	-	-	-	-	-	-	-	-	-	-	-	-	140			7

% Plants Showing	Moderate Use	Heavy Use	Poor Vigor	%Change
'83	85%	00%	00%	+24%
'89	23%	00%	00%	-66%
'97	26%	43%	.63%	+54%
'02	.58%	16%	08%	

Total Plants/Acre (excluding Dead & Seedlings)				
	'83	7132	Dec:	4%
	'89	9332		1%
	'97	3140		3%
	'02	6860		0%